CITY OF FAIRFAX
COMPREHENSIVE PLAN UPDATE
MOVING FAIRFAX FORWARD

BRIEFING PAPER SERIES
MULTIMODAL TRANSPORTATION

COMMUNITY DEVELOPMENT & PLANNING DEPARTMENT ◆ JUNE 2012

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EXECUTIVE SUMMARY

The City of Fairfax Planning Commission has initiated discussions regarding a complete update to the City's Comprehensive Plan, which was most recently amended in 2012. During the initial stages of these discussions, a series of Briefing Papers will be published on matters related to planning. The topics of the papers include:

- Comprehensive plan mechanics
- Regional development snapshot
- Census 2010 data update
- Public facilities and lands
- Sustainability and the environment
- Multimodal transportation
- Parking
- Economic development opportunities and partnerships
- Land use and zoning
- Fiscal Impact Analysis
- Models of development

The papers are intended to provide information that may be useful as the process to draft a new Comprehensive Plan moves forward. The papers will explore the aforementioned topics in detail, providing both a local perspective and examples of best practices that may be applicable to the City of Fairfax. In addition, the papers will provide context for the discussion by providing background information and, when applicable, a glossary of terms.

Due to its central location within the region, access to Metrorail and Interstate 66, and role as a hub for major thoroughfares (US-29, US-50, VA-123, and VA-236), the City has always taken an active role in transportation planning. Demand on the City's transportation infrastructure continues to be great, while attaining funding for enhancements has grown increasingly competitive. In order to leverage scarce resources, opportunities to coordinate land development and transportation initiatives remain a critical component of the City's future. Many jurisdictions are seeking

"multimodal" solutions (those that address multiple modes of travel, e.g., motor vehicle, transit, bicycle, and pedestrian) to address capacity deficits. This Briefing Paper examines creative solutions that the City has exercised in the past, as well as lessons learned from across the country. By examining national examples of both successful projects/initiatives and those that are less so, planning for the future can be better informed. Street design, roadway optimization, connectivity and linkages, transit use, and alternative transportation options are topics included in the paper. Parking, which relates to both the transportation network and local land use patterns, is considered separately in another Briefing Paper dedicated exclusively to that subject.

Introduction

The local transportation network is a fundamental element in the daily lives of most Americans. Most rely on the local transportation network to access employment, educational and religious facilities, goods and service providers, recreational activities, and social or family engagements. Depending on the context, the local transportation network is often comprised of a combination of streets, sidewalks, trails, and transit lines (fixed rail or rubber tire). Most local transportation networks can accommodate more than one mode of travel and as the network becomes more complete, the modal options tend to increase. Fortunately, other than separated walking / bicycling paths and transit lines, modes of travel can generally share the same streets.

As was noted in the *Comprehensive Plan Mechanics* Briefing Paper, the Code of Virginia (§15.2-2223) requires every locality to include a transportation plan within the comprehensive plan that identifies needs and recommendations (as well as cost estimates for any recommended projects) for streets, pedestrian and bicycle accommodations, and public transportation facilities (as appropriate). The Virginia Department of Transportation (VDOT) is also responsible for standards related to roadway design and integration of modes, but as an independent city with control over its own roadways, the City of Fairfax can choose to use a number of the standards as guidance without being required to comply with certain VDOT regulations. These directives and other guidance from the state combined with greater interest in alternatives has jurisdictions across the Commonwealth examining a broad range of measures to accommodate local transportation demand. Virginia is not unique in this regard, as jurisdictions around the country have become increasingly interested in cost effective and efficient transportation options. This renewed focus on travel by foot, bicycle, and transit in addition to a reconsideration of conventional assumptions regarding single occupancy vehicles has spawned a significant collection of best practices, examples, and recommendations/guidelines for multimodal transportation planning.

Multimodal planning refers to decision making that considers various modes (walking, cycling, automobile, public transit, etc.) and connections among modes so each can fill its optimal role in the overall transport system.

- Victoria Transport Policy Institute

Background

The rise of the automobile and the suburbanization of the United States have characterized development patterns across the country since the end of World War II. Because of the natural relationship between automobile accessibility and suburban forms of development, much of the built environment that Americans live in today was developed around this automobile orientation. The City of Fairfax, with the overwhelming majority of its housing stock built in the 1950s and 1960s, is served by a transportation system largely developed during this period.

As part of the rapid growth in the post-World War II era, land development patterns and the design of street networks changed from the pre-1940s model. Street geometry, street widths, design speeds, block sizes, connectivity standards, access arrangements, pedestrian facilities, and transit accommodations were all modified to accommodate a suburban style of development. These changes in street design justifiably centered around the motor vehicle, since that was the travel mode of choice

"Traditionally, through thousands of years of human settlement, urban streets have performed multiple functions. Mobility was one of the functions, but economic and social functions were important as well. Retail and social transactions have occurred along most urban thoroughfares throughout history. It is only in the 20th century that streets were designed to separate the mobility function from the economic and social functions."

- Designing Walkable Urban Thoroughfares: A Context Sensitive Approach – Institute of Transportation Engineers and Congress for the New Urbanism

for the new suburban dwellers of the 1950s and 1960s. As development has continued into the rural fringe over the last 40 years, some "early" suburban locations, like the City of Fairfax, have slowly become more urbanized and are now centers of activity in the region. The result of these settlement patterns is a region that is not only served by a single business and cultural district located at its core (i.e., Washington, D.C.), but by multiple centers of activity throughout the metropolitan area, each with unique aspects that contribute to its identity (e.g., Old Town Fairfax). These changes in the role of suburbs require an ongoing examination of how the street network and transportation system serve the community as it evolves.

Motor Vehicle

The motor vehicle, and in particular the single-occupancy motor vehicle, is the transportation mode of choice for the majority of Americans. Motor vehicles offer drivers freedom in terms of schedule, routes, speed, and companionship. While only a single reason for vehicle travel (albeit an important one), commuting data show the overwhelming popularity of the motor vehicle. According to the U.S. Census Bureau (American Community Survey, 2009), 90.0% of Americans that work outside of the home ride to work in motor vehicles. Single-occupancy drivers comprise 79.5% of commuters and 10.5% ride in carpools. Other commuting options comprise much smaller percentages: 5.2% take public transportation, 0.6% ride bicycles, 3.0% walk, and 1.2% use other means. Public policy and funding promoting the United States' expanding network of roads continues to offer drivers access to new areas with very few impediments for entry, such as tolls or other direct charges for using the infrastructure. This public policy history has given the motor vehicle a distinct advantage over other forms of transportation, such as those that require a fare box payment to use.

The popularity of motor vehicles has spurred continued increases in vehicle ownership levels and given rise to heavy use of the country's roadway networks. Other than minor pauses during the 1970s oil crises, the early 1990s recession, and the recent housing crisis and recession in 2008, vehicle miles traveled in the United States has grown continuously since the end of World War II (Americans currently drive over 3 trillion miles collectively on an annual basis). Researchers at the University of Connecticut report that the number of vehicle miles traveled per capita in the United States almost doubled from approximately 14 miles per day in 1970 to nearly 28 miles per day in 2007. To put this into context, the neighborhoods and street network in the City of Fairfax had largely been developed by 1970. The increase in the number of miles vehicles are traveling and the resulting

"Over 3/4 of the nation's workers drove alone to work."

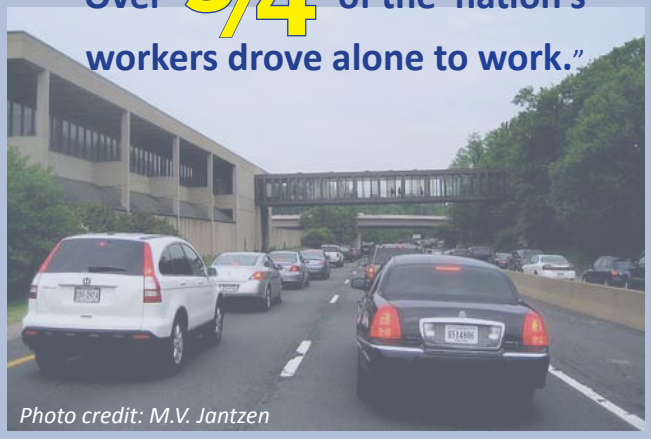


Photo credit: M.V. Jantzen

- Commuting in the United States: 2009, American Community Survey Report

increase in the duration of time spent on the road impact the accessibility of the street network for residents and business owners and places greater demands on local road maintenance budgets. While the long-term effects of the recent recession on vehicular travel may not be completely clear, resumption of the previous growth in vehicular miles in the decades to come would seem to have significant impacts on quality of life and economic stability.

Transit

As is evidenced by the data in the section above, transit use is a distant second to motor vehicles as a means of commuting (5.2% of Americans use public transportation to commute to work). Due to its limited availability in many parts of the country, the fixed nature of its routing, and the variability in the quality of service delivered by its providers, or any multitude of other reasons, ridership figures show that transit isn't the preferred method of travel of most Americans. Nevertheless, transit can have a significant impact on mobility within an individual region that is served by this mode. According to the U.S. Census Bureau (American Community Survey, 2009), the Washington, D.C. metropolitan area has the 3rd highest rate (14.1%) of public transit usage by commuting workers of the 50 largest metropolitan areas in the country (only behind the New York and San Francisco metropolitan areas).

Public transportation ridership grew steadily throughout the nation in 2011 resulting in 10.4 billion trips for the year, a 2.31% increase (+235 million trips) over 2010.

- American Public Transportation Association

Transit appears to be a growing mode of choice among technology users, particularly the young. Whereby bus cabins and train cars may deter some as being personally intrusive environments, researchers from DePaul University have found that "for many of today's young Americans, portable devices allow them to, in effect, privatize public space." Field research conducted between the fourth quarters of 2009 and 2010 found that technology usage increased for all surveyed bus and rail travelers, led by 46.8% of riders on Amtrak's high-speed trains in the Northeast Corridor using technology while in route. Commuter train, heavy rail, and curbside bus riders in the survey all used portable technology devices at a rate of 29.0% or greater by the end of 2010. The researchers contend that the ability to use technology while traveling may be creating some competitive advantages for modes that are considered slower than driving a personal vehicle since those modes allow for a more productive use of time. Data on the driving habits of those under the age of 30 may also support an increase in transit use among young adults, as the percentage of the total number of vehicle miles traveled in the United States by that age group dropped from 20.8% in 1995 to 13.7% in 2009.

Bicycle

U.S. Census Bureau (American Community Survey, 2009) data show that bicycles represent the smallest percentage of use (0.6%) of any travel mode as a means of getting to and from work. Bicycling as a share of all the trips made in the United States is slightly higher (1.0%) according to data from the 2009 National Household Travel Survey by the Federal Highway Administration. Bicycles tend to be used for shorter trips as 85% of all bicycle trips are for 3 miles or less, but bicycling can extend the range of non-motorized trips, as the percentage of walking trips falls significantly for trips between 1 mile (35% of all trips) and 3 miles (21% of all trips). While not the case worldwide, the data show that bicycling is largely a leisure time or recreational activity for most people in the United States.

Despite the smaller share of modal choice, attention has been given to bicycling as it can represent the primary form of transportation for particularly vulnerable populations, such as children, the poor, recent immigrants, and the developmentally-challenged. Given the consideration toward who is riding, much of the focus has turned toward issues of bicycle safety. Recent statistics would indicate that the focus is well-founded as an estimated 51,000 bicyclists were injured in traffic accidents in 2009 and nearly 20% of them (10,000) were under the age of 16 (according to the U.S. Department of Transportation).

Photo credit: www.pedbikeimages.org / Tiffany Robinson

In addition, the health benefits of bicycling have been acknowledged in recent years as concern over childhood obesity, high blood pressure, and other chronic illnesses has grown. Some have cited statistics regarding the reduction in children walking or riding bikes to school as emblematic of the increasingly sedentary nature of today's youth (over 40% of students ages 6-12 walked or biked to school in 1969, but that percentage had dropped to under 15% by 2001). Efforts directed toward addressing national trends in safety and physical activity levels are currently underway through programs such as Safe Routes to Schools.

Pedestrian

According to the 2009 National Household Travel Survey by the Federal Highway Administration, the average annual person walking trips per household increased by approximately 55% between 1990 (234) and 2009 (362). In addition, households in larger metropolitan areas (3 million or more persons) took 42% more person walking trips per household (514) than the national average (362). The survey found that the highest percentage of walking trips were for social and recreational reasons (46%) and for family and personal business/errands (37%). The ranking of family and personal business/errands, which the survey states includes activities such as shopping, getting a haircut, and attending a community meeting, as high as it is on a national survey indicates that walking remains one of the primary means by which Americans carry out the various aspects of their daily lives.

GRAPHIC 1: Walkability Standard

Source: Clarence Perry

Clarence Perry's neighborhood unit diagram (1929) ushered in the ¼-mile radius as a standard of walkability.

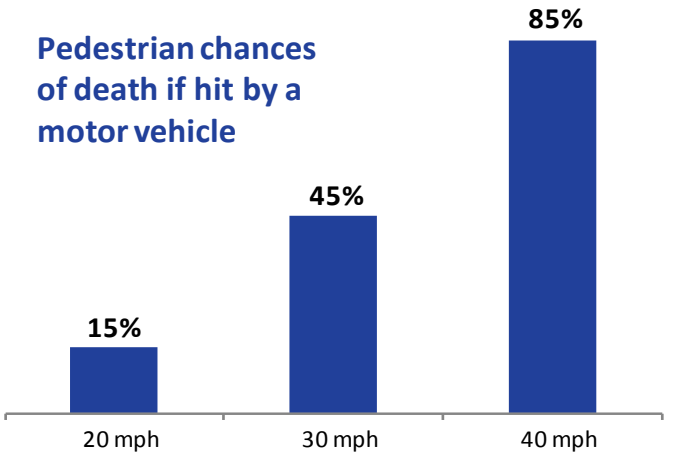
Conventional thinking on the extent of walking as a mode of transportation to compete with other modes has often centered on the distance the average person would walk to a destination. The resulting "standards" suggest that distances of ¼-mile (approximately a 5-minute walk) to ½-mile (approximately a 10 to 15-minute walk), depending on the destination (a park, shopping district, or transit station for example), are what most would reasonably walk before choosing another form of transportation. The data from the 2009 National Household Travel Survey confirm that shorter distances indeed glean a higher number of walking trips, but recent research indicates that not only the distance, but the number of obstacles a walker must traverse to reach the destination, as well as the perception of distance itself, are factors in the decision to walk or use another mode. Even commercial applications, such as the popular Walk Score® that is used to evaluate the convenience of housing to various types of amenities, are now moving beyond basic straight line (or "as the crow flies") distance measurements into calculations that

consider the actual distance along streets, the number of intersections, and block length to better capture the character of the pedestrian environment.

Safety

A review of safety as it relates to transportation could include any number of variables. In order to narrow such an expansive subject and align it with the focus of this paper, safety is examined as it relates to the interaction between the modes. Encouragingly, traffic fatalities across the country have been declining in recent years. Between 2000 and 2009, the number of traffic fatalities dropped by more than 19%. In 2009, 86% of the fatalities were occupants of motor vehicles, 12% were pedestrians, and 2% were bicyclists. Even with the decline, the 2009 rates still provide some very startling statistics regarding mortality on the country's streets. The U.S. Department of Transportation National Highway Traffic Safety Administration reports that in 2009, "on average, a pedestrian was killed every two hours and injured every nine minutes in traffic crashes." In the City of Fairfax, there were unfortunately 2 fatalities due to motor vehicle crashes in 2011, as well as 162 accidents with injuries, an increase in injuries of 6.6% from 2010. While typically gaining significant media attention, the number of transit fatalities nationwide is extremely low, particularly for bus, light rail, and commuter rail, as compared to number of fatalities of occupants of motor vehicles or of pedestrians.

CHART 1: Pedestrian Mortality



Source: United Kingdom Department for Transport

Research indicates that the prevailing factor in accidents, particularly those that are fatal, is vehicle speed. Often cited research from the United Kingdom Department for Transport found that likelihood of a pedestrian death increased 70 percentage points when vehicle speed rose from 20 mph to 40 mph (see Chart 1). Similarly, the severity of accidents and resulting injuries is closely related to speed as research has shown that for each 1 mph reduction in speed, injury accident frequencies reduce by 5%. Any number of factors can contribute to increased vehicle speeds and accidents, but a growing body of research suggests that lane widths greater than 11 feet, the absence of well-defined street edges (that may include curbs and sidewalks, trees, planters, on-street parking, or street furniture), and heavy reliance on passive traffic control measures (signs and pavement markings) can create an unsafe environment in urbanized areas.

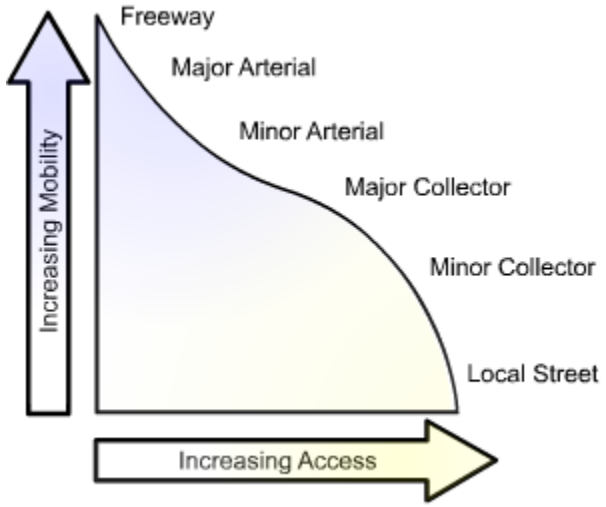
Transportation Planning / Traffic Engineering Terminology

As with most professions, transportation planning / traffic engineering has a "language" that is unique to its industry. Familiarity with the terminology used in transportation planning, and in particular the terms used within traffic engineering, is critical toward understanding the rationale behind, justification for, and decision-making related to transportation plans and projects. The following list provides a brief overview of some of the common terms:

Functional Classification

The functional classification system is a hierarchy of street types primarily used by state departments of transportation to classify streets within the statewide network. Streets are generally identified within the following classes: freeway, arterial (major or minor), collector (major or minor), and local, based upon their role within the overall network. The history of the functional classification dates back to the early efforts that eventually led toward the development of the national Interstate Highway System. Today, functional classification is used as a guide for street design, a method for determining maintenance payments and construction funding from state and federal sources, and a standard for operational features (such as on-

GRAPHIC 2: Conceptual Functional Hierarchy



Source: Federal Highway Administration

street parking). Critics of the functional classification system argue that it creates a rigid guideline for streets that doesn't reflect the changing character and resulting function of a street as its traverses from one area to another (since a tendency exists to designate the entire length of a street within one functional class). The Conceptual Functional Hierarchy (Graphic 2) depicts the dichotomy that exists when mobility (with its focus on the expedient movement of motor vehicles traveling through the street network) is the priority for arterials and access (which is focused on connections to individual properties) is relegated to minor collector and local streets. These resulting mobility standards, such as operating speed and traffic carrying capacity, can become problematic when an arterial serves a downtown business district or a "main street," for example.

Level of Service

Level of Service (LOS) is a method to evaluate and categorize traffic congestion. Traffic conditions are categorized "A" through "F," with their corresponding meanings intended to reflect grades on a report card. LOS is calculated at intersections and between intersections. LOS at intersections is calculated according to average overall time delay. LOS between intersections is calculated as a function of the ratio of vehicles to car carrying

Level of Service (LOS) Descriptions

LOS A describes conditions where traffic flows at or above the posted speed limit and all motorists have complete mobility between lanes. LOS A occurs late at night in urban areas, frequently in rural areas, and almost always in car advertisements.

LOS B is slightly more congested, with some limitations on maneuverability; two motorists might be forced to drive side by side, limiting lane changes. LOS B speeds are not necessarily lower than LOS A.

LOS C has more congestion than LOS B, where ability to pass or change lanes is not always assured. LOS C is the target for urban highways in many places. At LOS C most experienced drivers are comfortable; roads remain safely below, but efficiently close to, capacity; and posted speed is maintained.

LOS D is perhaps the level of service of a busy commercial street in the middle of a weekday, or a functional urban highway during commuting hours. Speeds are somewhat reduced, and motorists are hemmed in by other cars and trucks. In busier urban areas, this level of service is sometimes the goal for peak hours, as attaining LOS C would require prohibitively expensive lane additions, roadway widenings and bypasses.

LOS E is when traffic flow becomes irregular and speed varies rapidly but rarely reaches the posted limit. On highways this is consistent with a road that has exceeded it designed capacity.

LOS F is the lowest measurement of efficiency for a road's performance. Flow is forced; every vehicle moves in lockstep with the vehicle in front of it, with frequent drops in speed to nearly zero mph. Technically, a road in a constant traffic jam would be below LOS F.

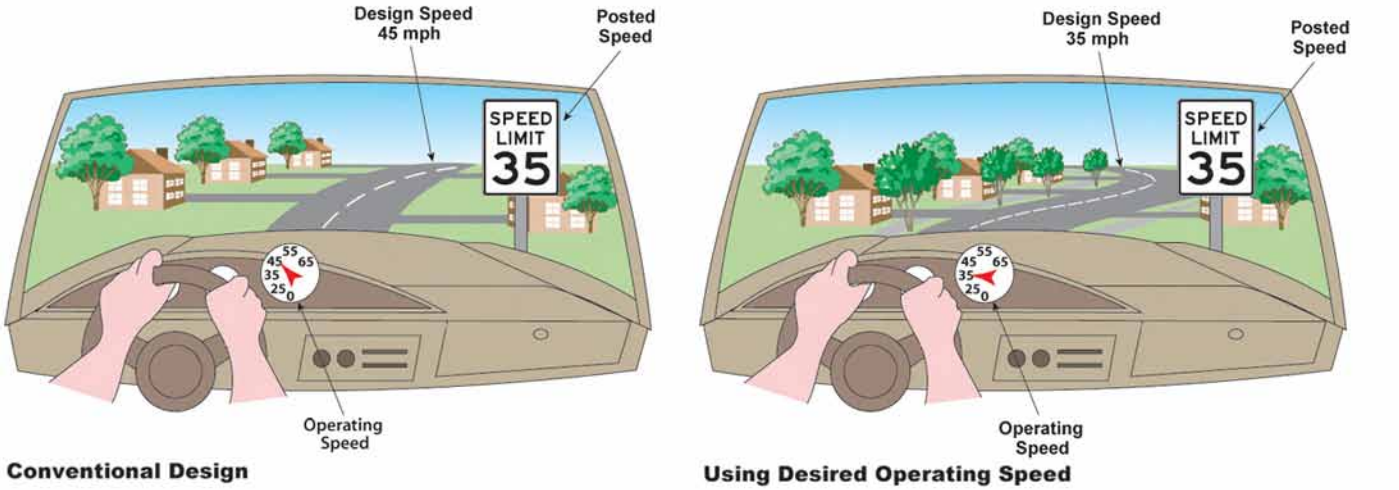
Source: A Citizen's Guide to Better Streets

capacity of the street. While there are no street design requirements related to level of service, streets are often designed to meet a level of service target for current or projected traffic levels. It is the practice of designing streets to maintain a targeted level of service for a projected future traffic level or peak-hour traffic level that has been brought into question in recent years for what can be viewed as the resulting "over design" of streets. Widening, removal of on-street parking, adding lanes, and limited pedestrian crossings, all of which impact the adjacent environment, are often concerns expressed when streets are perceived as being over designed. In lieu of strict adherence to vehicular LOS, alternative measures of transportation mobility are now being explored, including using multimodal levels of service or applying just the simple carrying capacity of streets within a network.

Design Speed

Along with the functional classification, design speed has been a primary consideration in street design. The concept of design speed originated in the 1930s from concerns over the safety of motorized vehicles traversing curves that were designed for non-motorized or slower moving motorized vehicles. For many years, design speed was defined as the maximum safe speed that a vehicle could travel on a given street segment. In order to quantify this speed, the typical operating speed of 85% of drivers over the street (the 85th percentile) became a benchmark in setting the design speed. The design speed was then typically set to 5 or 10 mph above the posted speed limit, in order to provide a safe environment even for those that exceeded the speed limit. Design speed is based on the concept that vehicles moving at faster speeds need more time to react, more time to stop once the brakes have been applied, and more distance to recover when a vehicle leaves the road. The standard of setting a design speed higher than the posted speed limit had a tendency to promote speeding, as motorists typically drive as fast as they believe a road can handle regardless of the speed limit, and affected the geometric features of the road, which were sized to accommodate higher speeds often to the detriment of other modes of transportation. The resulting drawbacks in this approach have spurred the use of an alternative, referred to as a "desired operating speed" or a "target speed." This alternative approach uses the context of the street, including adjacent land uses and presence of other modes of transportation, to set the speed. The resulting street design is intended to make the design speed, posted speed limit, and operating speed of motor vehicles the same (see Graphic 3).

GRAPHIC 3: Desired Operating Speed



Source: Smart Transportation Guidebook

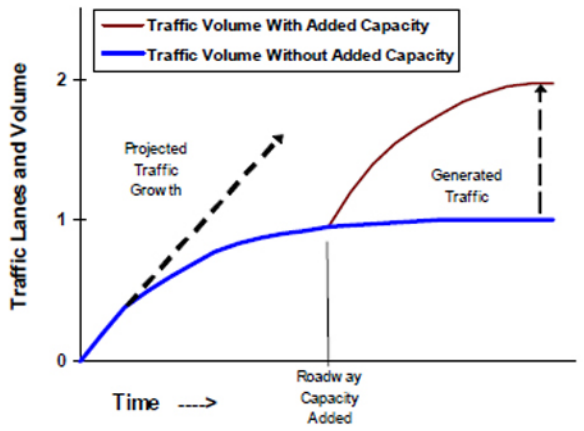
Induced Traffic

Research has found that induced traffic occurs in a manner consistent with the common economic theory of supply and demand. When the capacity of a street (the supply side) is expanded by a widening to address congestion, an increase in vehicles (the demand side) using that new capacity eventually results in an equilibrium similar to the condition prior to the widening (i.e., congestion). The short-term gains in reduced travel times facilitate additional vehicular travel demand from: trips diverted from other streets, increased discretionary trips that wouldn't have been made otherwise, changes in the time of day of travel, or choices to drive as opposed to using another mode of travel. These additional trips consume the added capacity. The resulting increase in vehicle miles traveled from an increase in total lane miles has prompted researchers to recommend that induced traffic be included in models for widening projects in order to accurately assess the proposed capacity and travel time benefits of the project.

Vehicle Miles Traveled

Vehicle Miles Traveled (VMT) is a mileage calculation, just as its name indicates. It can be expressed for a single vehicle, on an average basis, or collectively for a group of vehicles (for example, the previous Motor Vehicle section provided a figure for the United States as a whole). VMT is generally used to convey the travel characteristics of an area (city, region, or nation) as opposed to the use of a particular street or street section. Average Annual Daily Traffic (AADT), Average Daily Traffic (ADT), or similar measures, are calculated to assess the use of a particular street. Data from the Virginia Department of Transportation show that the City of Fairfax recorded 525,612 vehicle miles traveled every day on average in 2010. This ranked Fairfax the 31st highest in vehicle miles traveled among counties, cities, and towns in Virginia that don't have an interstate highway within their jurisdiction. Fairfax only fell behind much larger counties (geographically) and a few cities or towns (Danville, Leesburg, Lynchburg, and Manassas) in this measure.

GRAPHIC 4: How Street Capacity Expansion Generates Traffic



Traffic grows when roads are uncongested, but the growth rate declines as congestion develops, reaching a self-limiting equilibrium (indicated by the curve becoming horizontal). If capacity increases, traffic grows until it reaches a new equilibrium.

Source: Victoria Transport Policy Institute

Local Perspective

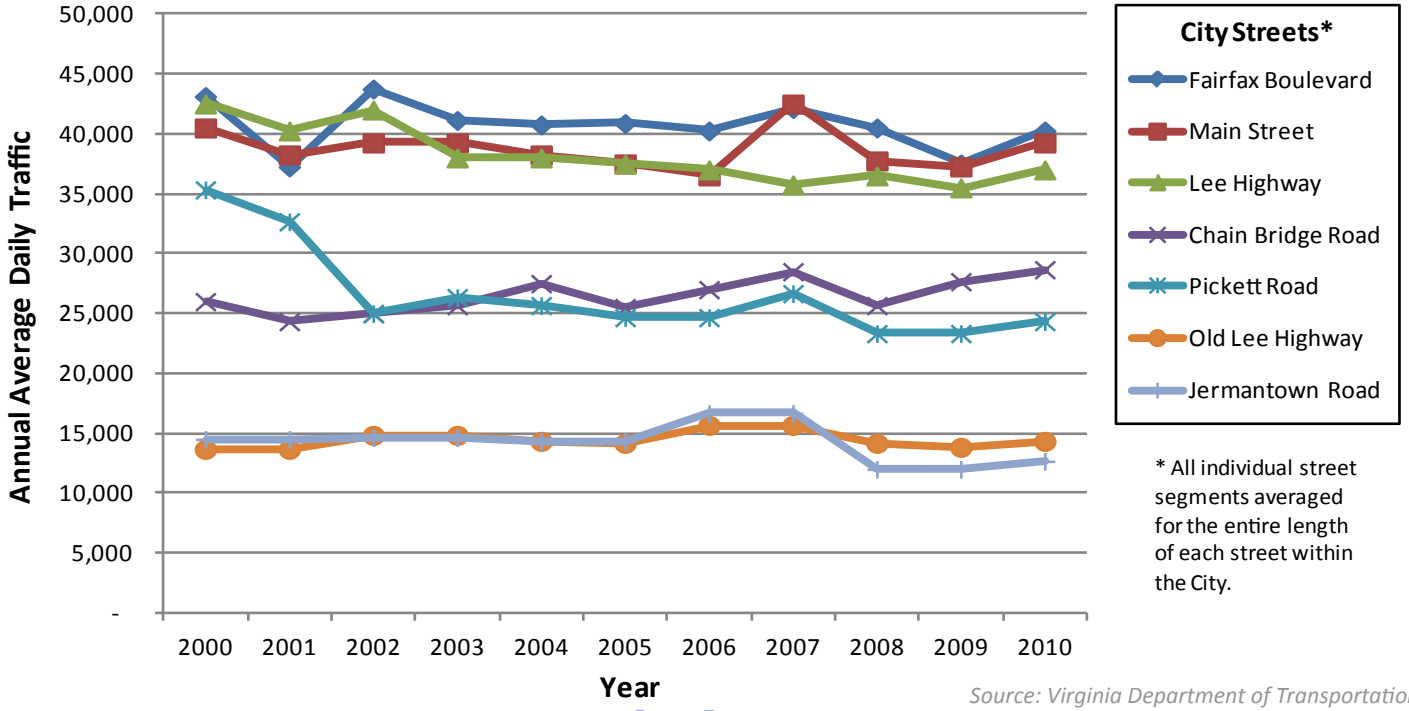
The City of Fairfax has served as a transportation hub since its inception as the Town of Providence in 1805, located at the crossroads of Little River Turnpike (now Main Street ~ Route 236) and Ox Road (now Chain Bridge Road ~ Route 123). Already home to the Fairfax County Courthouse, which created a prominent identity for the Town, its role in the region continued to grow in part due to its ability (provided by the access roads) to offer goods and services to travelers and residents in the surrounding countryside. The groundbreaking for present-day Fairfax Boulevard (Routes 29 and 50) in 1931 resulted in a bypass around the historic core at the Courthouse and confirmed the City's role as a key transportation corridor within Northern Virginia for decades to come. The portion of Interstate 66 north of the City opened in 1964, providing a limited-access highway from points west to the Capital Beltway (I-495) and an alternative to federal and state routes for motorists traveling longer distances. Main Street, Chain Bridge Road, Lee Highway, Pickett Road and Fairfax Boulevard continue to carry the bulk of the vehicular traffic in the City, but over time neighborhoods and commercial centers have continued to grow up beside them, so these streets (all designated as arterials) often serve a dual role for through traffic and local access.

Facts and Figures

The City's streets carry the bulk of transportation movements, including all of the motor vehicle and transit (CUE Bus, Metrobus, and special service providers) trips as well as bicycle and pedestrian trips. Nearly 175 lane miles (combined linear length of all lanes that move traffic during peak hours) exist on public streets in the City of Fairfax, which constitutes more than 85% of the total street network. Private streets, some of which are located within commercial centers, but most are within residential areas, account for the remainder of the system. The residential areas that have private streets are generally either multifamily or townhouse developments, as well as larger planned communities such as Farrcroft and Great Oaks. Private streets predominately exist within "closed systems," which don't provide connectivity to other portions of the street network.

Traffic on the City's streets, particularly the arterials, is reflective of the high volume experienced throughout much of Northern Virginia. The most recent (2010) annual estimates of daily vehicular traffic provided by the Virginia Department of Transportation show the highest counts in the City on Fairfax Boulevard at the eastern City line (49,000) and Chain Bridge Road at the northern City

CHART 2: City of Fairfax Traffic Counts



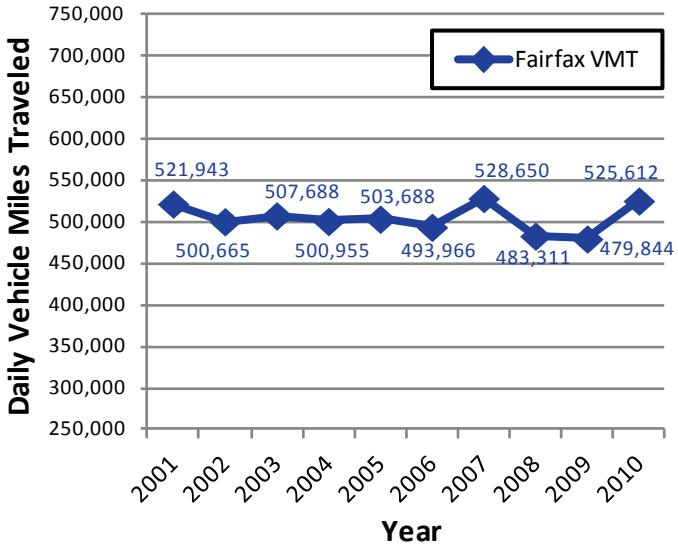
Source: Virginia Department of Transportation

line (44,000). Although, the data show that the segment of Fairfax Boulevard between the western City line and the intersection at Kamp Washington (US-29, US-50, and VA-236) has carried the highest average since 2000 at nearly 52,000 vehicles per day. The estimates for each of the individual roadway segments have been combined in Chart 2 to provide an annual average for the entire length of some of the more heavily-traveled streets in the City (the figures for Lee Highway include only those exclusively-named street segments at the eastern and western ends of the City and do not include any overlap with Fairfax Boulevard). Interestingly, the data show some variation in the early portion of the decade followed by relative stability in traffic levels through 2007, at which point the number of vehicles on City streets generally dropped before beginning to slightly rise again in 2010. This fluctuation is consistent with the national trend in reduced vehicular travel cited in the previous Motor Vehicles section that started at the beginning of the recession in 2008.

In similar fashion, the number of vehicle miles traveled in the City of Fairfax dipped during 2008 and 2009 (as shown in Chart 3), but rebounded in 2010 to nearly the pre-recession level and was the 2nd highest daily total recorded in the last 10 years. Given the significant number of vehicles on the roads and the number of miles they travel every day, the average one-way travel time for City of Fairfax residents to their places of employment was 31.4 minutes according to the U.S. Census American Community Survey (2009), slightly under the average for the entire region. At 33.4 minutes, the Washington, D.C. metropolitan region has the 2nd longest commute times in the country behind only the New York City metropolitan area. "Inner" jurisdictions, such as Alexandria (29.6), Arlington (26.5), and Falls Church (25.8), have commuting times well below the regional average.

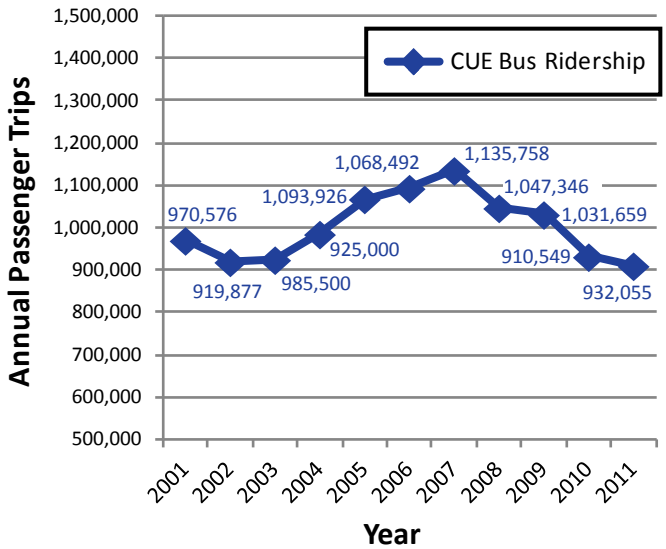
Included within the commuting travel time data are not only those traveling in private vehicles, but also those that use transit. As was mentioned in the previous Transit section, some researchers have concluded that transit riders will accept a potentially slower means of transportation (and the assumed longer travel time that would result) because of the other benefits derived from that mode of travel. In the City of Fairfax, ridership on the City's local transit system, the CUE bus, grew steadily between 2002 and 2007 reaching more than 1.1 million riders in 2007. Similar to the overall trend in traffic counts and vehicle miles traveled, CUE bus ridership numbers fell after 2007. Unlike the recent uptick in traffic counts and vehicle miles traveled, the CUE bus ridership figures have continued to drop since 2007. While the effects of the economic recession may have been responsible for the initial drop in ridership, the introduction of the George Mason University shuttle bus between the University and the Vienna/Fairfax-GMU Metrorail station in 2009 is a likely factor in the decrease in ridership since that time.

CHART 3: City of Fairfax Daily Vehicle Miles Traveled



Source: Virginia Department of Transportation

CHART 4: CUE Bus Annual Passenger Trips



Source: Northern Virginia Transportation Commission

Existing Transportation System

The City's existing transportation system is comprised of a network of streets, transit routes, bicycle routes, trails, and sidewalks. Each component of the system is described in the following sections.

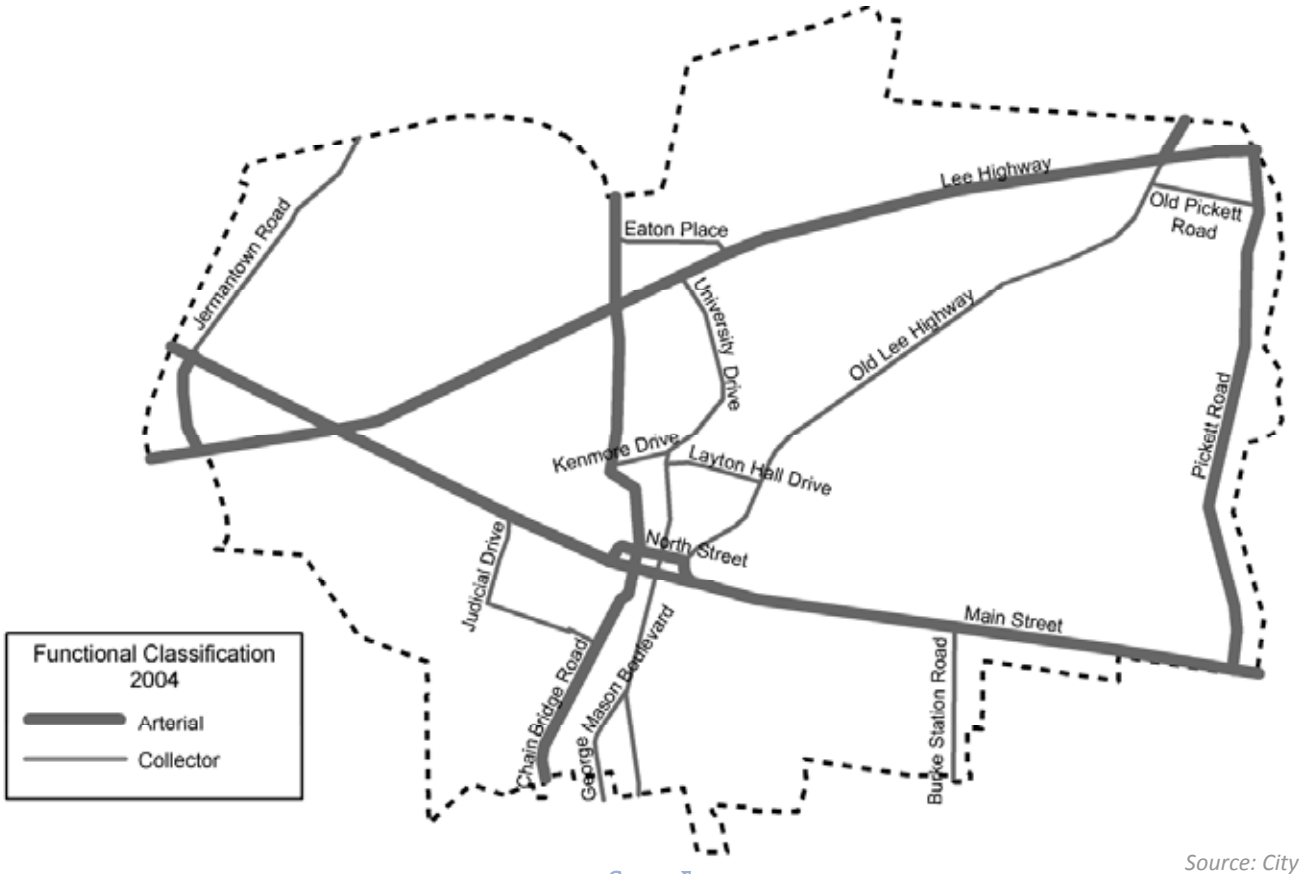
Streets

As is noted in the previous Functional Classification section, streets are categorized into a hierarchy according to their role within the roadway network. Map 1 shows the streets identified in the City as arterial or collector. An arterial street, as classified by the Virginia Department of Transportation (VDOT), "serves the major centers of activity of a metropolitan area" and is one of the "highest traffic volume corridors." VDOT also identifies arterials as those streets that carry long trips and a large portion of the total area travel. Collector streets can provide access to residential, commercial, or industrial areas and collect and distribute trips from arterial and local streets. Local streets have a primary purpose of providing access to adjacent properties (as opposed to serving traffic moving through an area). Measuring by length, 21% of the City's streets are classified as arterial and 5% are classified as collector. The remainder of City streets (74%) are classified as local. The percentage allocation of City streets within the various functional classifications falls within the Federal Highway Administration's guidelines.

Transit Routes

CUE (City University Energysaver) bus, which began service is 1980, is the primary public transit service in the City. The bus system, which is owned and operated by the City and funded in part by George Mason University, serves all of the primary corridors and surrounding neighborhoods in the City (see Map 2). CUE has provided service to and from the Vienna/Fairfax-GMU Metrorail station since its opening in 1986 and links George Mason University with the City. The bus service operates on four routes (Green 1 & 2 and Gold 1 & 2) seven days a week with 30-35 minute frequencies on weekdays and 60-65 minute frequencies on weekends.

MAP 1: City Street Hierarchy



Source: City of Fairfax

MAP 2: CUE Bus routes

Source: City of Fairfax

A survey of CUE bus riders conducted in 2008 by the Metropolitan Washington Council of Governments provided ridership characteristics at that time. Approximately 70% of riders indicated that they had walked to the bus stop to catch the bus and would walk to their destination after departing the bus, revealing the importance of the transit service as the primary mode of motorized transportation for a significant percentage of riders. 22-23% of riders rode Metrorail in conjunction with CUE and 5-6% transferred to or from another bus service before or after their CUE bus trip.

In August 2009, CUE became the first bus system in Northern Virginia to introduce hybrid diesel buses. Six

buses of the twelve buses in the CUE fleet are hybrid diesel, utilizing a combination of electric and diesel power (electric power is the primary source). The buses have lower emissions, use less diesel fuel, and are quieter than standard combustible diesel engine buses.

Metrobus, a service of the Washington Metropolitan Area Transit Authority, has routes that pass through the City of Fairfax (see Map 3). The three principal routes within the City traverse Chain Bridge Road (15M), Fairfax Boulevard (1C), and Main Street (29K). These routes provide CUE bus riders and other City residents with connections to destinations beyond the CUE bus service area, such as: Tyson's Corner, Fair Oaks Mall, and Northern Virginia Community College. Metrobus and CUE bus accept SmarTrip® fare cards and deploy Next Bus software to track arrival times on mobile devices and over the telephone, both of which ease the transition between the two providers.

In addition to CUE bus and Metrobus, George Mason University operates a shuttle service for students and faculty that runs exclusively between George Mason University facilities and the Vienna/ Fairfax-GMU Metrorail station without any intervening stops.

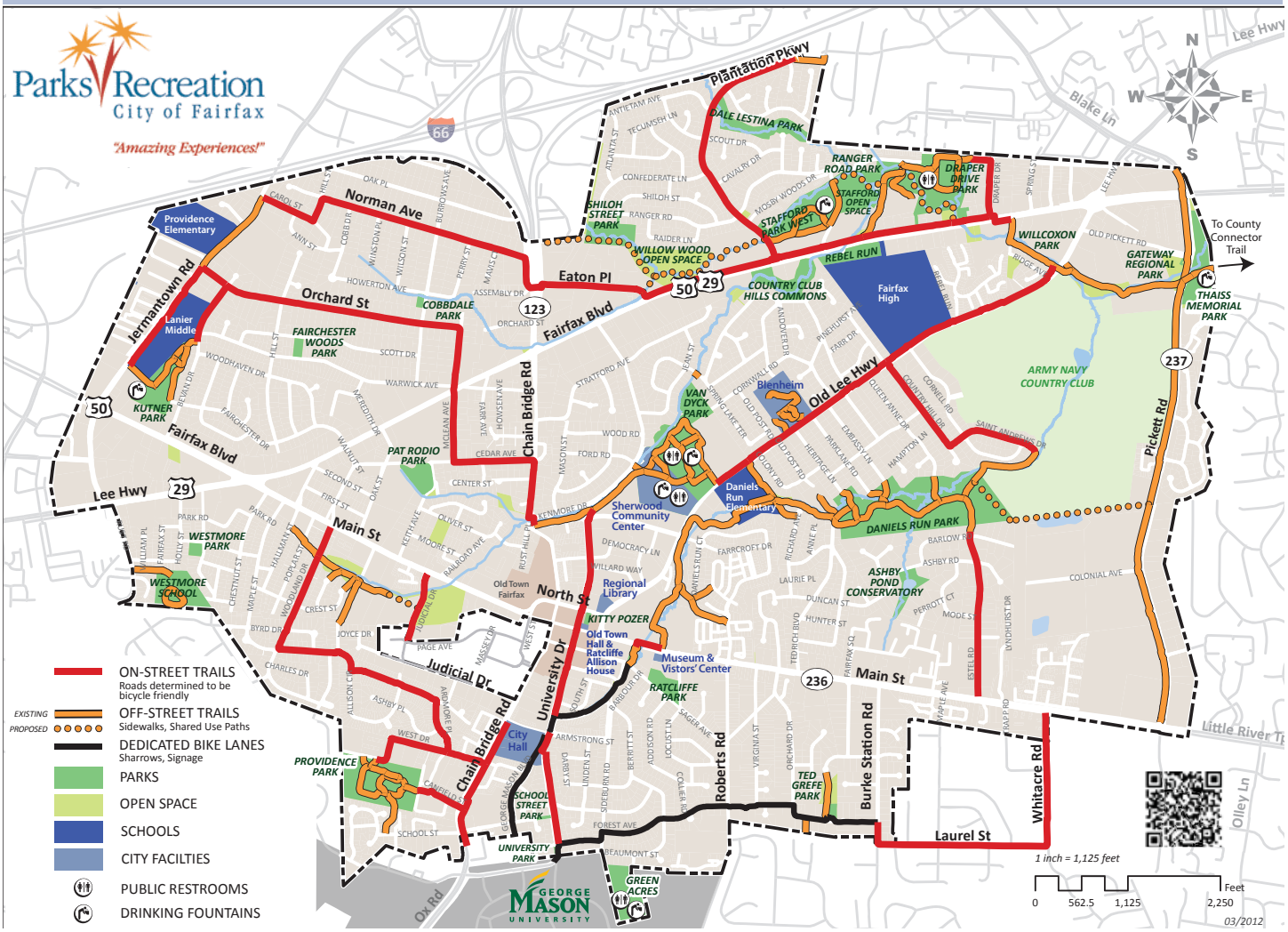
MAP 3: Metrobus routes in the City of Fairfax

Source: Washington Metropolitan Area Transit Authority

Bicycle Routes and Trails

Bicycle routes and trails in the City of Fairfax include both on and off-street facilities (see Map 4). The on-street facilities include routes specifically signed for bicycles, bike lanes, and sharrows (shared vehicular and bicycle travel lanes). A number of streets have also been identified as "bicycle friendly." These are primarily residential streets or are other streets that provide convenient linkages between neighborhoods and destination points. These streets are deemed "bicycle friendly" due to their lower traffic volumes or capacity to comfortably handle bicycle and vehicular traffic. The off-street facilities are generally multipurpose recreational trails that serve bicyclists, joggers, and walkers. Although, the off-street trails often serve more than just a recreational purpose, as they tend to provide more direct path of travel (than do streets) for bicyclists and walkers undertaking trips of all purposes.

MAP 4: City of Fairfax Bicycle and Trail Facilities

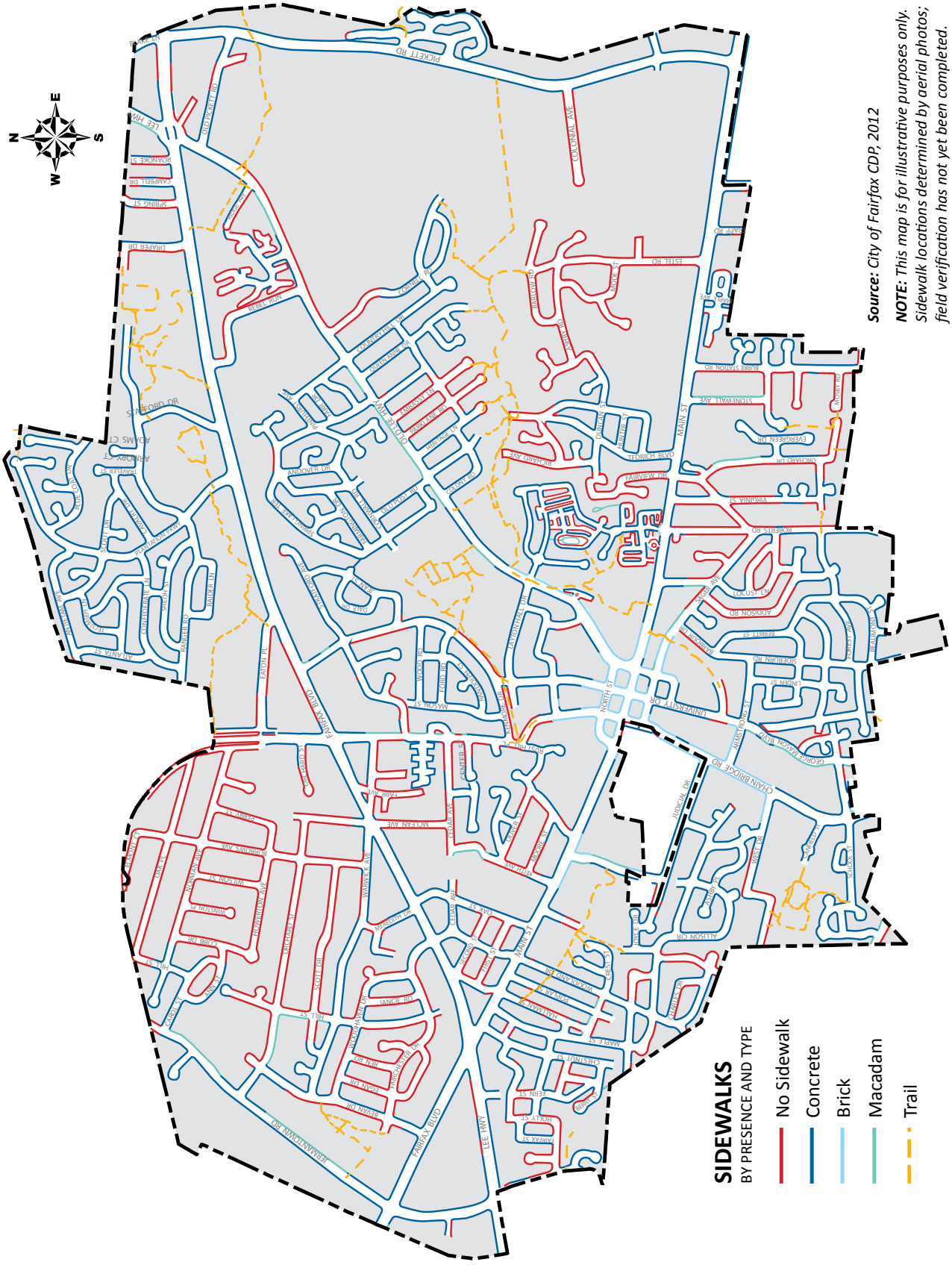


Source: City of Fairfax

Sharrow markings were added in 2011 along George Mason Boulevard between the University and the bike lane on Breckinridge Lane.

Photo credit: City of Fairfax

MAP 5: City of Fairfax Sidewalk Types



Source: *City of Fairfax CDP, 2012*

NOTE: *This map is for illustrative purposes only. Sidewalk locations determined by aerial photos; field verification has not yet been completed.*

Sidewalks

With certain exceptions, City streets generally include sidewalks (see Map 5). The city maintains approximately 165 miles of sidewalk (and the associated curb and gutter, driveway entrances, and handicap ramps). In the mid-1970s, brick sidewalks and crosswalks began to be installed in the Old Town Fairfax area of the City. The installation of brick sidewalks and crosswalks has extended into the Transition Overlay District (area surrounding Old Town Fairfax) in recent years as sidewalks have been rebuilt through City-sponsored capital improvement projects or as a part of adjacent redevelopment projects. The installation of sidewalks on both sides of the street is a requirement in the City's subdivision ordinance, although it is important to note that many neighborhoods were built prior to the City's incorporation in 1961.

Plans and Projects

Despite being a largely developed City with most infrastructure in place and little unimproved land, a number of transportation-related projects completed in recent years, and others in the planning stages or currently underway, have affected (and will affect) how people move throughout Fairfax.

Old Town Fairfax

The most significant transportation project in Old Town Fairfax in recent years was the conversion of North and Main Streets from a one-way pair to two-way traffic on both streets (a two-way traffic pattern had existed previously until a conversion to a one-way pair was completed in 1972). Completed in 2006 as part of a larger effort to improve the downtown environment, numerous streetscape improvements accompanied the traffic direction conversion, including wider sidewalks, additional street furniture, and new landscaping. Research has shown that through careful consideration of the full impacts of a one-way system versus a two-way system, including the traditional measures of roadway capacity and vehicular delay as well as the more contemporary measures of pedestrian safety and mobility and retail storefront street exposure, conversion to two-way traffic often yields a greater overall benefit to a downtown area.

"The conventional wisdom has always assumed that one-way streets were safer and more comfortable for pedestrians to cross than two-way streets. Superficially, it would seem that crossing the single direction of traffic on a one-way street is always preferable to crossing a two-way street. As is often the case, the conventional wisdom is wrong. In fact, crossing a one-way street presents greater difficulties to the pedestrian than crossing a two-way street. The explanation lies in the greater number of different vehicle/pedestrian conflict sequences [2 versus 16] that are encountered in crossing the one-way street."

- Transportation Research Board Circular E-C019

To assist in circulation and visibility, efforts are currently underway to improve directional and parking identification signage in and around Old Town Fairfax.

Fairfax Boulevard

Planning and street design work is currently underway at three major intersections along Fairfax Boulevard. The intersections of Fairfax Boulevard with Chain Bridge Road (Route 123) and Jermantown Road, as well as all of the street approaches at the Kamp Washington intersection (Routes 29, 50, and 236) would be reconfigured as part of these efforts. The projects generally involve some combination of: widening the roadway, adding lanes, extending turn lanes, realigning lanes, adjusting curb locations and radii, adding mast arm traffic signals and pedestrian signals, and/or signal phasing changes. Extensive work to the drainage system in and around the intersection of Chain Bridge Road and Fairfax Boulevard is also included within that project.

Trails

The City's trail system continues to evolve as additional sections are added to the network. As depicted in Map 4, a number of new trail sections have been proposed

to fill gaps or provide linkages to new destinations. The dedication of property and/or trail construction through the negotiated land development process has added a number of key trails to the City's system. Residential developments such as Chancery Park and Farrcroft have included trails that serve the public, and residential development underway at Main Street Residences and Cameron Glen (on the west side of Judicial Drive between the Burkholder Building on the Fairfax County Courthouse Complex and Main Street) will provide a link between an existing trail and a public street. A trail easement dedicated as part of the Boulevard Marketplace project on Fairfax Boulevard west of Plantation Parkway provides an opportunity to extend the trail system that the City constructed through the Stafford Drive Park property. Consideration is given toward expanding the trail system in all applicable public and private development projects.

Use of the City's trails and streets by George Mason University faculty, students, and visitors, in particular those traveling between the University and the Vienna/ Fairfax-GMU Metrorail station, has provided the impetus for an emerging effort to formalize the route between the two destinations. Acceptance of a formal route would require collaboration between the University, the City, and Fairfax County, as it would pass through each jurisdiction. Discussions regarding a "Mason2Metro" bicycle route are in the early stages.

Stafford Drive Park Trail

Photo credit: City of Fairfax

Regional Plans and Studies

A number of transportation plans and studies being developed on a regional level could have an impact on the City's future transportation network. The coordinating framework for regional transportation planning is the Financially Constrained Long Range Transportation Plan, which includes all of the significant projects throughout the region over the next 25 years, and the Transportation Improvement Plan, which includes all of the significant projects in the region that will be funded over the next 6 years. While extremely important as these dictate where state and federal transportation funds will be directed, both function more as budget or financial planning documents than they do as policy plans. The projects that are included in these two documents, which are approved by elected officials from around the region that serve on the Metropolitan Washington Council of Government's Transportation Planning Board, usually originate out of other plans or planning processes.

Metropolitan Washington Household Travel Survey

The Metropolitan Washington Council of Governments has chosen the City of Fairfax as a survey area for its Household Travel Survey of selected communities within the region (approximately 20 areas are to be surveyed). The survey, which is scheduled to be conducted during the Fall of 2012, will inquire with City households about household demographics, living arrangements, and vehicle ownership and use. In addition, each member of the surveyed household will complete a one-day travel diary that will document all of the individual's travel for the day by time, mode, and location. Results of the survey will be analyzed for inclusion in regional transportation planning studies, but those results will also provide Fairfax with a snapshot of the travel habits of City residents, which can be used to help assess local transportation projects and policies.

Some ongoing or recently completed plans or studies that could influence the transportation network in Fairfax include:

I-66 Transit/Transportation Demand Management Study (2009) This study, conducted by the Virginia Department of Rail and Public Transportation, identified short and medium-term transit and demand management improvements. One of the key recommendations in the study related to the City includes implementing a priority bus service along I-66 that could begin to develop the infrastructure necessary for a westward expansion of Metrorail.

I-66 Tier 1 Environmental Impact Study (Underway) This study, which is currently underway and slated for completion in December 2012, builds off the 2009 I-66 study (as well as an I-66 Major Investment Study conducted in 1999) and will prioritize improvements to be evaluated in further detail (Tier 2 of the study process). Highway, transit, and technology improvements will be considered and the study will satisfy the Virginia Department of Transportation's initial requirements for the proposed projects under the National Environmental Policy Act.

TransAction 2040 (Underway) The output of this planning process, which is projected to continue through December 2012, will be an updated regional transportation plan for Northern Virginia. This plan, prepared by the Northern Virginia Transportation Authority, is developed for a similar time horizon as the Financially Constrained Long Range Transportation Plan (CLRP), which was discussed at the beginning of this section. It identifies the projects that will be recommended for inclusion in the CLRP and thus ultimately recommended for funding. This plan allows for new projects to be considered that hadn't previously been included in the CLRP.

SuperNoVa Transit/Transportation Demand Management Vision Plan (Underway) This planning process, which is intended to examine transit and demand management options, expands the footprint of what is normally considered the region by including areas as far south as Caroline and Culpeper Counties and as far west as West Virginia, as well as the District of Columbia and Maryland to the north. Examined in the study will be the relationship between transportation and land use and how transit can most effectively serve this larger region. This plan, which is under the direction of the Virginia Department of Rail and Public Transportation, will take a similar time horizon as a number of the others mentioned previously (2040).

Regional Transit System Plan (Underway) The Washington Metropolitan Area Transit Authority has begun a plan for the continued development of its Metrorail facilities through 2040. While still in the early stages, an initial evaluation of extending the Orange line from Vienna/Fairfax-GMU to either Centreville or Gainesville has been completed. Suburb-to-suburb service, in addition to the existing "hub and spoke" service focused on the District of Columbia, has also been considered in the early planning discussions.

Fairfax Countywide Bicycle Transportation Plan (Underway) Fairfax County is currently in the process of developing a bicycle transportation plan that would identify improvements needed to encourage and facilitate bicycling within the County and to/from adjacent jurisdictions. Previously, the County had a bicycle map that identified preferred routes and dedicated on and off-road facilities, but did not have a plan for continued development of the bicycle network. The countywide planning process began after the completion of a bicycle plan specifically for the Tyson's Corner area. A number of Fairfax County bicycle routes and trails connect to the City, including the Accotink Creek Trail that links to the City's Thaiss Park.

Best Practices / Learning from Others

The number of contributors to the discussion on best practices in transportation has grown in recent years as a broader array of modes has received greater attention and as the recognition of the relationship between transportation and land use has increased. The resulting mixing of disciplines and professional expertise has undoubtedly served to enrich the conversation on multimodal transportation and has brought numerous new ideas to light. As was mentioned at the beginning of this document, parking will be addressed in another Briefing Paper, but it is important to note the prominent role that parking maintains in transportation and land use planning.

The examples of best practices have been categorized into sections below as a means to organize them in this Briefing Paper, but in reality there is a significant amount of overlap between all of the concepts, as it is difficult to implement just a single aspect of a multimodal transportation system.

Street Design

As was noted in the Introduction, streets generally carry all or nearly all of the modes of transportation within a community. Having such a high level of responsibility for the functioning of the overall transportation system, great emphasis is placed on street design. Regardless of individual interpretations of the hierarchy of streets or the functional classification system, streets do indeed serve a variety of purposes and thus street designs vary to accommodate those functions. Variations in street design are applied during the initial construction of a street or as part of a retrofit. Particularly in urban areas, the overwhelming majority of street design work is on existing streets, often conducted to accommodate changes in development patterns or preferred performance qualities (such as traffic calming).

Context Sensitive Solutions

Acknowledgement that context is relevant likely represents the most fundamental innovation in street design in recent years. This shift in thinking, and the resulting development of Context Sensitive Solutions (CSS) for street design and traffic management, has allowed for consideration of factors other than strictly the movement of vehicles in how streets are designed. The publication of the American Association of State Highway and Transportation Officials' (AASHTO) *Guide for Achieving Flexibility in Highway Design* in 2004 as a companion to AASHTO's *A Policy on Geometric Design of Highways and Streets* (commonly known as the "Green Book") confirmed the integration of Context Sensitive Solutions into the industry and it continues to serve as a primary guideline for flexibility in street design.

Context sensitive solutions (CSS) is a collaborative, interdisciplinary approach that involves all stakeholders in providing a transportation facility that fits its setting. It is an approach that leads to preserving and enhancing scenic, aesthetic, historic, community, and environmental resources, while improving or maintaining safety, mobility, and infrastructure conditions.

- AASHTO and Federal Highway Administration

While CSS provides an umbrella for flexibility, specific implementation measures for best practices in street design come from a variety of sources.

Complete Streets

Complete streets are just what the name infers, streets with a complete range of facilities to accommodate all of the desired modes of travel. The complete streets philosophy is grounded in safe access for all users that doesn't place priority on one mode of travel over another. The particular facilities provided on a complete street will vary from one context to another, but the underlying fundamentals remain the same. A complete street may include, but isn't limited to some combination of: vehicle travel lanes (no greater than 11 feet in width), dedicated transit lanes, bicycle lanes, on-street parking, transit shelters, sidewalks, pedestrian and street lighting, shared use paths, street trees, crosswalks, pedestrian signals, pedestrian refuge areas, and curb extensions. Sustainable stormwater management techniques, such as those contained within the "green streets" implemented in Portland, Oregon and described in the *Sustainability & The Environment* Briefing Paper, are also becoming more common features of complete streets.

In order to formalize the complete streets approach to street design, many communities around the country are adopting complete streets policies. The policies address any range of issues particular to the individual community. In May 2012, the Transportation Planning Board (TPB) of the Metropolitan Washington Council of Governments adopted the Complete Streets Policy for the National Capital Region. The policy encourages jurisdictions within the metropolitan area to adopt or amend local complete streets policies with common elements in order to establish a baseline for standard content within the policies themselves and to provide a common measure for evaluating projects for state and federal funding.

Excerpt from the Complete Streets Policy for the National Capital Region

The following ten elements, which are endorsed by the National Complete Streets Coalition, should be part of a [local] comprehensive Complete Streets policy. An ideal Complete Streets policy:

- Includes a vision for how and why the community wants to complete its streets.
- Specifies that "all users" includes pedestrians, bicyclists and transit passengers of all ages and abilities as well as trucks, buses and automobiles.
- Encourages street connectivity and aims to create a comprehensive, integrated, connected network for all modes.
- Is adoptable by all agencies to cover all roads.
- Applies to both new and retrofit projects, including design, planning, maintenance, and operations for the entire right of way.
- Makes any exceptions specific and sets a clear procedure that requires high-level approval of exceptions.
- Directs the use of the latest and best design standards while recognizing the need for flexibility in balancing user needs.
- Directs that complete streets solutions will complement the context of the community.
- Establishes performance standards with measurable outcomes.
- Includes specific next steps for implementation of policy, such as:
  - Revising agency procedures and regulations to reflect the policy
  - Developing or adopting new design guides
  - Offering training for staff responsible for implementing the policy
  - Gathering data on how well streets are serving different user groups

- Metropolitan Washington Council of Governments

Photo credit: Dan Burden

Elements of a complete street incorporated into Hamburg, NY's main street include: wide sidewalks, curb extensions, well-marked crosswalks, on-street parking, and colored pavement to narrow the travel lane.

Road Diets

As is noted in the Background section of this Briefing Paper, the number of vehicle miles traveled in the United States has grown substantially since the 1940s. In order to manage the number of vehicles on the road through traditional measurements (see the Level of Service section of this paper), common practice has been to add vehicular travel lanes. Research has shown that not only is the added lane capacity consumed by additional vehicles (see Induced Traffic section of this paper), the added lanes themselves don't provide consistent increases in capacity (see Graphic 5). In the context of an intersection, the capacity added by each additional lane is increasingly reduced due to: the time it takes to clear an intersection during a signal phase, the time it takes to provide protected left turns(s) during a signal phase, pedestrian crossing times for more lanes of traffic, and the behavior of drivers to not fully utilize all of the lanes as number of lanes increases.

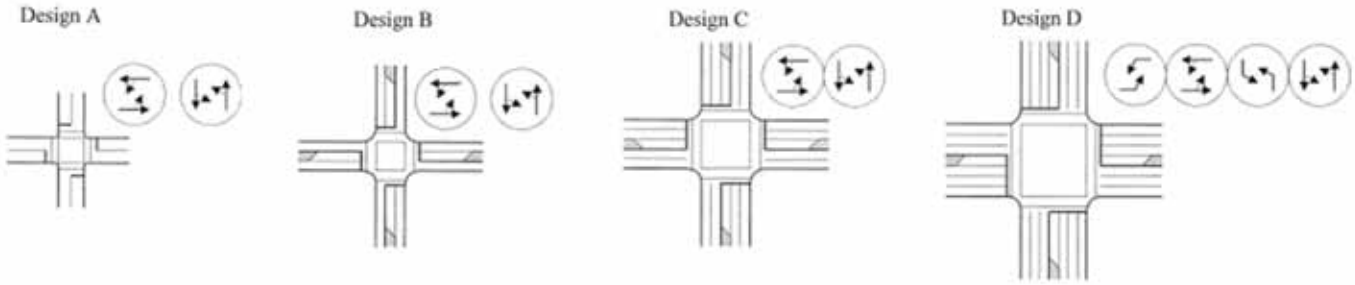
These types of findings have prompted a number a number of jurisdictions around the country to either reconsider plans to add lanes or even reduce the number of vehicular lanes on existing streets to expand the capacity of the street for other modes of travel. The resulting "road diet" projects have been found to increase safety for all modes and increase access to the streets significantly for pedestrians and bicyclists, while not impacting the number of vehicles that use the streets.

For example, the City of Charlotte, North Carolina converted East Boulevard, a street used by more 21,000 vehicles on average each day that serves a number of commercial, residential, and institutional properties, from a four-lane undivided street into a three-lane street with pedestrian refuge islands and bicycle lanes (conversions from four lanes to three lanes are usually considered for streets carrying up to approximately 20,000 vehicles on average per day, but some communities have converted streets carrying as many as 25,000 vehicles or more). Data taken both before and after the road diet show that: the average annual daily traffic on the street rose within a year of the project's completion, the operating speed of vehicles was reduced, and vehicular travel time was not significantly impacted. A similar project in Orlando, Florida, also found that the crash rate, injury rate, and incidence of speeding was reduced, while pedestrian counts and the utilization of on-street parking increased after the road diet.

Connectivity

Design isn't limited to the features of a street from curb-to-curb, but also how the entire street network is configured to serve its users. The design of street networks has varied considerably over time (a grid pattern typical of pre-1940s development was often replaced by trunk and branch pattern during the United States rapid suburbanization after World War II) and has

GRAPHIC 5: Intersection Lane Configurations



Single lane	Adding left turn lane	Adding 2nd through lane	Adding 3rd through lane
625 vehicles per hour	+240 vehicles per hour	+483 vehicles per hour	+463 vehicles per hour

The intersection designs demonstrate the diminishing capacity of vehicular travel lanes as more are added to an intersection. For example, a 2nd through lane (Design C) carries nearly ¼ fewer vehicles per hour than the 1st lane (Design A). These results have prompted the study's authors to caution, "…expanding intersections above a certain size, especially in locations where traffic growth is high, may be an expensive, ineffective and short-lived solution to the traffic-congestion problem."

Source: ITE Journal

East Boulevard in Charlotte, NC was converted from a four-lane street into a three-lane street with pedestrian refuge islands and bicycle lanes as part of a "road diet" project.

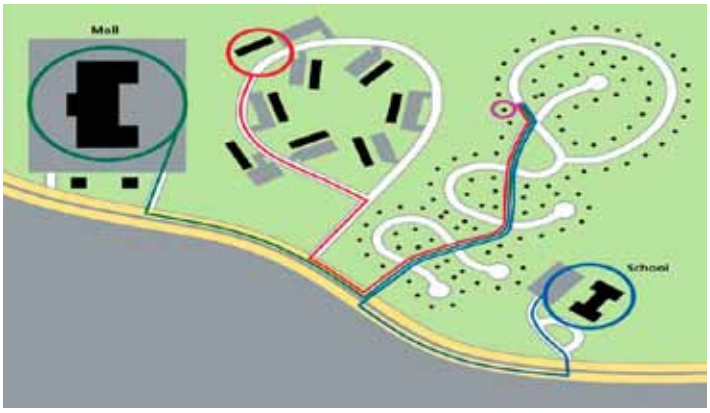
Photo credit: Charlotte Department of Transportation

had a profound effect on the nature of development that surrounds it and how the streets are used. Research has shown that not only is an obvious factor, such as travel time, affected by how streets are connected, but even something that may be less intuitive, such as the rate of walking, is affected by the connectivity of the network. Those street networks with more intersections (i.e., greater connectivity) are associated with higher levels of walking and bicycling and are generally found to be safer when accounting for all modes of transportation.

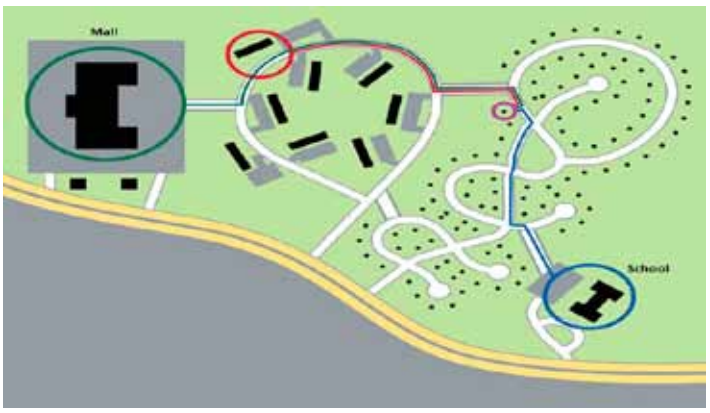
Fiscal considerations are also increasingly becoming a factor in decisions to develop connected street networks or extend connections in areas previously separated. Longer vehicular routes increase municipal service response times or schedules, as well as operating costs, for police cars, fire trucks, school buses, and refuse/recycling trucks. Maintenance costs (paving, snow removal, etc.) for streets that serve a limited number of properties have given rise to state and local governments developing new standards that ensure greater public benefit is derived

GRAPHIC 6: Street Connectivity

Disconnected



Connected



In its standards for accepting streets into the state maintenance system, the Virginia Department of Transportation (VDOT) cites the benefits of multiple connections between neighborhoods and other activity centers as a means to reduce reliance on primary thoroughfares and expand the street network.

Source: VDOT Secondary Street Acceptance Requirements

from streets by requiring a certain level of connectivity in new development. As part of the Virginia Department of Transportation's regulations associated with accepting newly constructed streets into its maintenance inventory, VDOT requires that development projects that meet certain thresholds in terms of number of residential units or vehicular traffic generated provide additional external connections to nearby existing or planned streets. While these Secondary Street Acceptance Requirements don't apply to a Virginia jurisdiction that maintains its own streets (such as the City of Fairfax), the inclusion of connectivity standards by a state department of transportation indicates the movement within the transportation industry toward more connected street networks.

Street Classification

The conventional method to classify streets, and its perceived limitations, are noted in the Functional Classification section of this paper. The recognition that a single street can serve a number of functions over its entire length, and thus not be easily assigned to a single functional classification (arterial, collector, or local), has encouraged the development of alternative forms of designating streets within a hierarchy. The state departments of transportation in New Jersey and Pennsylvania collaborated on a roadway categorization approach that serves as an overlay to the functional classification system. The overlay doesn't replace the functional classification system, or the design parameters associated with it, but the overlay refines functional classification by providing more detail on desired operating speeds, volume of traffic, and intersection spacing. By detailing these measures, the overlay "focuses more narrowly on the characteristics of access, mobility and speed."

"If a segment of an arterial roadway has a relatively low speed, is important to community access, and has a lower average trip length, it should not be designed like a high order arterial."

- Smart Transportation Guidebook

The concept of refining conventional street classification, not just for the overall network, but for particular types of roadways, has also been advanced in recent years. For example, *Designing Walkable Urban Thoroughfares*, a joint publication from the Institute of Transportation Engineers and the Congress for the New Urbanism, segments urban thoroughfares into context zones (according to the physical form and type of activity adjacent to the street) and recommends that those streets be considered on a block-by-block basis. Urban thoroughfares may be in areas that already have a reasonable level of walking or in areas where there is a desire to encourage walking. Urban thoroughfares, which bridge the conventional classifications of arterial, collector, and local, are categorized in these guidelines into boulevards, avenues, and streets, each with its own operational characteristics and design standards (see an example in Graphic 7). Similar efforts to move away from a one-size-fits-all approach to residential street design by more clearly defining characteristics that are appropriate to various contexts have also been completed in recent years.

GRAPHIC 7: "Street" Walkable Urban Thoroughfare Type

A "street" within the walkable urban thoroughfare framework, which could be categorized as an arterial, collector, or local under the functional classification system, is recommended to contain features that support its context, including: 2 vehicular travel lanes, bicycle lanes or sharrows, on-street parking, and sidewalks.

Source: Designing Walkable Urban Thoroughfares

Pedestrians and Bicyclists

While their accommodations are different, pedestrians and bicyclists are often grouped together in research and advocacy efforts, undoubtedly as they represent the primary modes of non-motorized transportation. The presence of pedestrians in particular, but also bicyclists, across the transportation system (on streets and in transit, for example) actually provides the opportunity for these modes to influence the broader system beyond their singular modes. As such, innovation in terms of policy and practice for pedestrians and bicyclists are noted in this section, but some best practices are also mentioned in the previous Street Design section and in the later Mixed Use Development section.

Multimodal Levels of Service

Levels of service standards for modes of transportation beyond just the motor vehicle have been devised in recent years to evaluate the effectiveness of transportation networks from a multimodal perspective (Levels of Service as it pertains to traffic congestion is described in the Transportation Planning / Traffic Engineering Terminology section of this paper). Jacksonville, Florida included a Quality/Level of Service standard in its comprehensive plan in order to evaluate and score mobility for its street, transit, bicycle, and pedestrian facilities. The standard uses a grading system to evaluate each mode of travel by the quantity and quality of each mode. The average for each mode is used to evaluate necessary improvements within various areas of the city.

GRAPHIC 8: Multimodal Levels of Service

Assessments of service levels for pedestrians and bicyclists in a manner similar to what has been traditionally conducted for motor vehicles is becoming increasingly more common.

Source: Florida Department of Transportation

Bicycle Facilities

While bicycles can mix safely with vehicles on residential streets and in slowing moving traffic in commercial areas (either with or without sharrows), facilities dedicated exclusively to bicycle use are becoming more common in areas where some degree of separation between bicycles and vehicles is desired. Traditionally, separated paths were the primary means to provide a designated location just for bicycling. In rural or low-density suburban areas, right-of-way width may allow for a separate bicycle facility, but in urban areas or those that are otherwise more densely developed, the land necessary to provide a separate path may not be an option. A new approach to dedicated facilities for bicycling, the cycle track, provides an interesting

Photo credit: AJFroggie

Example of a cycle track in Washington, D.C.

Photo credit: Fairfax Advocates for Better Bicycling

A new W&OD Trail bridge was constructed over I-495 in June 2011 as part of the express lanes project on the Capital Beltway.

combination of an in-street facility and a separated path (see image above).

A cycle track is constructed between the sidewalk and the vehicle lane, but is different from a normal bicycle lane in that it is separated from vehicles by bollards, on-street parking, or a restricted zone marked on the street, and not just a single painted line. Cycle tracks can also be raised to the sidewalk level, but remain separate from the sidewalk. Cycle tracks can be one-way or two-way, but two-way operation offers the opportunity for bicyclists and motorists to face each other in adjacent lanes, instead of traveling in the same direction. Depending on the context, any number of features can be incorporated into a cycle track that can increase the comfort of bicyclists and motorists alike.

Trail facilities continue to serve a prominent role in recreational bicycling, but have also taken on more importance for other types of bicycle trips. The popular W&OD Trail that extends 45 miles across Northern Virginia received an improved crossing of Interstate 495 as part of the construction of express lanes in 2011. In addition, the express lanes project will include sidewalks and bicycles lanes on all 58 of the bridges replaced as part of the overall project. While bicycle infrastructure represented a very small portion of the total project, important linkages were made across the interstate, which normally represents a major barrier to bicycle and pedestrian access.

Arlington, Virginia is using its focus on improved bicycle facilities to support desired bicycle ridership levels in the county. The Arlington Master Transportation Plan includes a goal of exceeding 50% of county residents using bicycles as a "normal and accepted travel option" on at least an occasional basis. The plan identifies implementation measures that would improve bicycle facilities at destination points (through the provision of showers, lockers, and bicycle parking in office buildings for example) in addition to those that would expand facilities on county streets. Ridership levels are monitored through citizen surveys and automated counting devices, which the county began installing in 2009 on multi-use trails.

Pedestrian Facilities and Programs

"Walkable" pedestrian environments, those in which pedestrians feel safe and comfortable, are often described as having buildings, public spaces, streets, and infrastructure that support walking both indirectly and directly though their placement, scale, and design. The size of sidewalks, the location of crosswalks, the relationship of buildings to the sidewalk, the type and placement of street furniture, the presence of elements that provide enclosure (as opposed to exposure) for walkers, lighting, shade, the speed of adjacent traffic, and the number of vehicular curb cuts are just a few examples of the elements that are considered when evaluating pedestrian environments. Walking surveys, pedestrian planning,

Photo credit: K.W. Barrett

The City of Falls Church developed a Safe Routes to School (SRTS) Plan in 2011 as part of the city's overall Pedestrian, Bicycle, and Traffic Calming Strategic Implementation Plan. The SRTS Plan component outlines the city's approach toward improving walking and bicycling access to its four schools. Falls Church was awarded $472,300 in 2012 for new and repaired sidewalks, bike and pedestrian crossing improvements, and traffic calming/ speed reduction measures for Mt. Daniel Elementary School and Mary Ellen Henderson Middle School.

Source: Virginia Department of Transportation

streetscape design guidelines, public facility manuals, and Americans with Disabilities Act (ADA) compliance audits, are all examples of measurement tools or policies that jurisdictions around the country are using to evaluate and plan for pedestrian activity. Improving walkability in a community is often achieved through a combination of programs and projects.

The widely known Safe Routes to School (SRTS) is an example of an initiative that uses both programs and projects in its approach. Safety education, organized walking events, curricula recommendations for schools, outreach efforts to parents and the community at large, developing partnerships with corporations and other supportive organizations, and coordinating policy at the national, state, and local levels are all programmatic approaches that the SRTS program deploys to encourage walking. With dedicated funding provided through the Federal Highway Administration, states receive allocations annually for SRTS. While the funds can be used to support programs, the federal allocations are relied upon heavily for projects that improve the infrastructure necessary for walking. Jurisdictions in the Commonwealth of Virginia can apply on an annual basis for funding.

Transit Innovation

As funding for rail projects has become scarce due to competition for the funds and the unpredictability of the funding streams, a number of jurisdictions around the country are examining options to improve bus service as an alternative. Everything from on bus wireless internet access to electronic message boards at bus stops displaying real-time bus arrival information and interactive voice response systems that allow mobile phone users to check arrival times remotely are being deployed to provide higher quality service. As was noted in the previous Transit section of the paper, access to technology is especially important to younger transit riders, so operators are examining a range of options to make their service more attractive to this demographic group. Encouragingly, with a fairly long history of transit service, residents of the Washington, DC region are familiar with, and generally supportive of, improvements in public transportation.

Beltway Poll of Virginia, Maryland, and D.C. residents (February 2011)

"There is virtually universal support for expanding public transportation options. Ninety-one percent support the idea. Nine of 10 residents also think walkable neighborhoods should be encouraged, and 9 of 10 believe jobs should be located closer to where people live."

- WTOP (March 5, 2012)

Bus Rapid Transit (BRT), considered a higher quality and more efficient type of bus service, has been implemented in more than a dozen U.S cities, and is being studied or planned for many more. Initial investment costs for BRT are significantly lower than light or fixed rail since it doesn't require the same level of infrastructure, but it does provide many of the features that rail service provides, which differentiates BRT from standard bus systems. The individual components of BRT vary from system to system, but can include: fully or partially-dedicated running ways (that separate the buses from general traffic), traffic signal priority and pre-emption (to improve travel times), transit stations (as opposed to bus stops), station-based fare collection (instead of on-board), and stylized buses that more closely resemble rail cars. While major cities are still the only implementation sites in the U.S., priority bus service studies along the I-95 and I-66 corridors in Virginia (and in other metropolitan areas) demonstrate that expansion of BRT as a part of a larger regional system in the U.S. may be on the horizon (Montgomery County, Maryland recently announced early plans for long-term build-out of a 160-mile BRT system with connections to Washington, D.C. and Prince George's County).

Photo credit: Institute of Transportation and Development Policy

"Cleveland's first BRT line opened in 2008. The HealthLine stretches 6.8 miles along Euclid Avenue, connecting the city's main employment centers, including downtown Cleveland, the Cleveland Clinic, and University Hospital, coming within a half mile of more than 200,000 employees and 58,000 households. In just three years, ridership has increased more than 60 percent over the bus routes that formerly ran along the corridor."

Source: Streetsblog.org

Alternative Transportation / Demand Management

Individually, or in combination, technological advances and collaborative efforts are improving transportation. Intelligent Transportation Systems (ITS), which have provided roadway monitoring devices and alternative routing information, are now moving toward real-time data capture and predicting demand based upon weather conditions. These and other technology improvements are making transportation more efficient and are allowing networks to be utilized to the maximum extent possible.

As technology continues to make transportation more efficient, so are new alternatives in accessing the transportation system. For example, at George Mason University, students and faculty have as-needed access

Photo credit: D.C. DOT

Capital Bikeshare, a partnership of Arlington County and the District of Columbia, has over 1,500 bicycles available for use by its members (memberships range from daily to yearly).

Source: Capital Bikeshare

to vehicles through a Zipcar® subscription service or can find a seat in another student or faculty's car through the University's Zimride ride share program. Reservations for both the car service and the ride share can be made via the internet. In addition, George Mason has implemented a bicycle commuter benefit program which provides students and faculty that are regular riders to campus with monthly vouchers to area bike shops, access to showering facilities on-campus, and a limited number of free daily parking passes (which could be used in inclement weather). The on-demand car service, ride sharing program, and bicycle benefit program all assist George Mason in managing its demand and providing a more efficient transportation service to its students and faculty.

GRAPHIC 9: Transportation Efficient Land Use and Design Guide

Image credit: Fluvanna County Prototype Town Center Street

The Virginia Department of Transportation issued a guide for local governments in 2012 that outlines planning and design strategies and a sampling of the mechanisms available for implementing complementary forms of streets and development. The recommendations include considerations for comprehensive planning, zoning, subdivision, urban design, parking, and street design. Examples of Virginia localities that have incorporated the principles of traditional neighborhood development (compact, non-automobile dependent), through plans, ordinances, and guidelines are also included.

Source: Virginia Department of Transportation

Mixed Use Development

As land use patterns dictate where travelers live, work, and shop, the location of housing, employment centers, and commercial development represents a significant consideration in transportation planning. A movement toward reducing the number of trips required to complete the activities of daily life, which can save time, provide convenience, and reduce congestion, has given rise to mixed use development. Mixed use development integrates a number of complementary uses (such as office, multifamily residential, and retail) into compact, walkable environments under the auspices that this will not only be an attractive environment in which to live and work, but it will also reduce the impact upon existing transportation infrastructure. In many ways, mixed use development is a return to the more traditional town and city building that was the norm prior to the rise of the automobile.

The benefits of mixed use development in terms of traffic generation had largely been relegated to anecdotal evidence and rough estimates until recently. Trip generation is a commonly applied measure to gauge the impact that a new development (or redevelopment) will have on nearby streets. Trip generation rates calculated by the Institute of Transportation Engineers for a large range of use types are the standard used in traffic engineering, but these standards had failed to provide solid calculations for mixed use development (because of less familiarity with this type of development and fewer studied examples). New methodologies that have been applied to a small, but growing number of new mixed use developments have found that the internal capture of trips (or trips generated by a new development that remain within the new development itself and do not impact adjacent areas) "is significantly related to the development's

Photo credit: TChamber236

RiverPlace, a 32-acre development in Portland, Oregon, demonstrated a 36% internal capture rate of trips under new mixed use traffic generation modeling, resulting in an overall traffic impact that is much smaller than a comparable single-use development.

Source: Planning Magazine

land area, employment, jobs-population balance, and density of intersections." Interestingly, intersection density also appeared in the new methodology's findings regarding influences on walking and transit use.

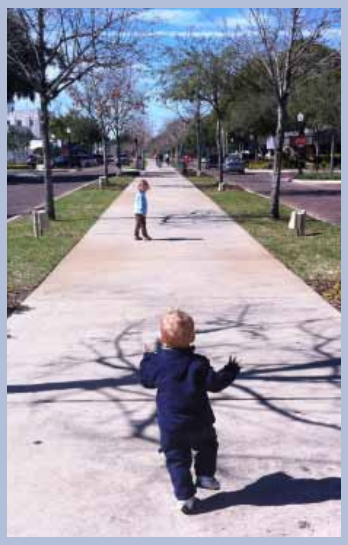
While there is no formula for mixed use development and the supporting transportation infrastructure, guidance is available through examples of successful projects already in existence and through programs designed to encourage compact, walkable development. In Virginia, enabling legislation in the Code of Virginia provides for the designation of Urban Development Areas (UDAs) in a jurisdiction's comprehensive plan. UDAs, which were made voluntary for all Virginia jurisdictions during the 2012 Virginia General Assembly session, can encourage increased density in specified areas. While the suggested density levels are relatively low (4 single-family residences, 6 townhouses, or 12 multifamily units per acre and a floor area ratio of at least 0.4 per acre for commercial), the legislation does encourage consideration of a growth horizon of 10 to 20 years, as well as the incorporation of traditional neighborhood development principles. Also voluntary, the LEED for Neighborhood Development® (LEED-ND) program through the U.S. Green Building Council has a rating system that evaluates development projects (with sizes generally ranging from 2 buildings up to 320 acres) based upon their location and linkages, neighborhood pattern and design, and green infrastructure and buildings. The factors considered for LEED-ND® certification combine "green" initiatives (what LEED® is generally known for) with concepts of smart growth and new urbanism. Projects receiving LEED-ND® certification are resultantly transportation efficient.

Twinbrook Station, a planned 26-acre redevelopment in Rockville, Maryland, received Gold certification through LEED-ND®.

Source: U.S. Green Building Council

Health and Wellness

Concern over the wellbeing of the country's citizenry generally, as well as that of special populations, such as children and the elderly, has given renewed interest to how safe transportation systems are, as well as how they may promote or discourage physical activity. Statistics regarding the increase in health issues related to sedentary lifestyles are prevalent in the media, giving rise to an examination of all aspects of daily life. As mentioned in the previous Bicycle section, the rate of children walking or riding their bicycles to school has dramatically decreased over the last 40 years. The pending growth in the number of seniors due to the aging of the Baby Boom generation has raised issues of access and safety in transportation networks. Advocacy groups from Safe Routes to School to the American Association of Retired Persons (AARP) have launched educational and funding efforts to improve the transportation environment for the old and young, particularly as it relates to walking. Encouragingly, the measures suggested for both demographic groups are often the same (e.g., complete sidewalk and bicycling infrastructure).



"Walking is the oldest and most efficient, affordable, and environmentally friendly form of transportation. Walking is the first thing human beings want to do, and the last thing they want to give up."

Source: Implementing Projects to Support Active Living

Concluding Summary

While technology and innovation advance transportation efficiency, a renewed recognition of traditional development patterns and emphasis on the importance of non-motorized transportation surprisingly provide complementary, not conflicting, guidance toward more accessible and complete multimodal transportation systems. Using all of the available guidance, the City of Fairfax will be well-equipped to give careful consideration of the interrelatedness of the elements that comprise its multimodal transportation system.

The Pennsylvania Department of Transportation distills its approach to transportation into 10 seemingly universally-applicable themes that succinctly summarize the information in this paper:

1. Money counts
2. Understand the context; plan and design within the context
3. Choose projects with high value/price ratios
4. Enhance the local network
5. Look beyond level-of-service
6. Safety first and maybe safety only
7. Accommodate all modes
8. Leverage and preserve existing investments
9. Build towns not sprawl
10. Develop local governments as strong land use partners

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